USE OF CHLORAMINES

Rules Affected: 30 TAC §290.39(j), §290.39(l) and §290.42(e)(3)(G)

Background:

This TCEQ staff guidance is provided to TCEQ staff in order to assure consistent, reasonable review of exception requests. In this document, the word "you" refers to TCEQ staff performing that task.

Many public water systems (PWSs) use, or are converting to, chloramines as a disinfectant in treatment processes and throughout the distribution system. Chloramines maintain a longer-lasting disinfectant residual and also help to lower the levels of disinfection byproducts such as trihalomethanes and haloacetic acids that are produced by chlorine disinfectants. With chloramines, less free chlorine is available for interaction with naturally-occurring organic matter, thus reducing the potential to form trihalomethanes and haloacetic acids.

Chloramines are formed by combining ammonia and chlorine. The chemistry of this reaction is described by the 'breakpoint' reaction, which is primarily dependent upon pH and the ratio of chlorine to ammonia-nitrogen (Cl_2:NH_4:N). Regulations in Title 30, Texas Administrative Code (30 TAC) §290.110—which set minimum and maximum disinfectant residual levels—require monitoring for total chlorine, which measures the sum of all oxidative species present: free chlorine, monochloramine, dichloramine, trichloramine, and any oxidative organoamines. The desirable species is monochloramine, which is responsible for disinfection.

Chloramines can cause serious medical problems to persons dependent on dialysis machines unless the chloramines are completely removed from the water that is to be used as a dialysate. A medical condition called hemolytic anemia can occur from use of dialysate produced from water that contains chloramines. Since the 1990s, most dialysis machines are manufactured with the needed chloramine removal technology, but old machines may still be in use. Additionally, chloramine is much more toxic to fish than chlorine.

30 TAC §290.39(j) requires a PWS to notify the TCEQ in writing prior to changing from chlorine to chloramines. An exception will need to be requested on behalf of the PWS to use chloramines in their system, as 30 TAC §290.42(e)(3)(G) states that the use of a disinfectant other than chlorine is to be considered on a case-by-case basis under the exception guidelines of 30 TAC §290.39(l). All requests for exceptions must be received and approved (or denied) in writing by the TCEQ. Once written notification and an exception request is provided to the TCEQ, staff will review grant or deny the exception, as well as notify the PWS whether engineering plans and specifications are required.

Guidance:

1. **Notification:** The notification of a proposed change to chloramines and the exception request must be submitted to the TCEQ in writing by the water system's owner, representative, or professional engineer.

2. **Grant or Deny Exception:** The exception request will be granted, or further information will be requested, based on a review of the submittal's merits and after review by the Water Supply Division teams and the applicable region. Appropriate correspondence will be drafted and sent to system officials. The correspondence will either:

    a. State why the exception cannot be granted, and request additional information for further review if needed; or,

    b. Grant the exception request and formalize conditions the PWS must meet to sustain the granted exception.

The most recent template letter should be used as the initial letter draft. The template letter is located in:

J:\PDW\0 TROT\Exceptions\LETTERS\42 Water Treatment - Letters\Chloramines

3. **Plan Review:** Rule 30 TAC §290.39(l)(1) states that requests for exceptions are to precede the submission of engineering plans and specifications. If the Utilities Technical Review Team (UTRT) receives a submittal for an exception request, the submittal will be forwarded to TROT so that the exception request(s) can be logged into the Water Utilities Database (WUD) for evaluation by TROT.

    a. If engineering plans and specification were not received by TROT with the written notification, TROT must determine whether they are required. Engineering plans and specifications are not required if:

        i. The submittal states that the PWS will be purchasing ANSI/NSF-Standard-60-certified liquid ammonia sulfate (LAS) stored in 55-gallon drums, and a sufficient quantity of LAS will be provided to meet maximum demand for 15 days in fewer than two drums;

        ii. The submittal states that adequate spill-containment facilities for the LAS drums exist or will be provided by acceptable spill-containment skids;

        iii. The submittal includes specifications for the chemical feed facilities;

        iv. No change in the current chlorine disinfection type (e.g. , gas to sodium hypochlorite) is proposed; and,

        v. All current and proposed chlorine and LAS application points are identified.

    b. If TROT determines that engineering plans and specifications are required after this chloramines exception is granted, the TCEQ's correspondence will contain the following conditions to be met by the PWS:

        i. Engineering plans and specifications must be submitted to the UTRT for review; and,

        ii. The PWS must receive written approval to construct from the UTRT before construction can be started.

c. If TROT determines that engineering plans and specifications are not required, the TCEQ's correspondence will state that the PWS is not required to submit engineering plans and specifications.

4. **Concentration Time (CT) Study:** Consideration must be given to the CT study. A CT study is an evaluation of a water treatment plant's disinfection process. CT studies are based on the concentration of the disinfectant and the theoretical contact time of the disinfecting chemical during the treatment process. A PWS that is required to meet inactivation requirements for *Giardia* and viruses must have a TCEQ-approved CT study - this includes systems that treat surface water (SW), ground water under the influence of surface water (GUI), and compromised groundwater sources. If the PWS submitting the request is required to have a TCEQ-approved CT study, the exception request must be reviewed to determine if a new or revised CT study is required.

   a. **A new CT study is required if:**

      i. The system is making its initial switch from free chlorine to chloramines or meets any of the listed conditions in bullet point (b) below.

      ii. The system is a new surface water (SW), groundwater under the influence of surface water (GUI), or groundwater treatment plant with a compromised well required to achieve 4.0-log removal / inactivation of viruses.

   b. **A revised CT study is required if any one of the following is proposed:**

      i. New chemical application point(s); or,

      ii. Modifications that will change the volume of a treatment unit; or,

      iii. Any other condition that TROT determines will require verification of the inactivation credit required to meet the treatment technique requirements.

   c. If a revised CT study is not received, but **is required**, and this exception request has been granted, the TCEQ's correspondence will contain the following conditions to be met by the PWS:

      i. A revised CT study must be submitted to TROT for review within 10 days from the letter date; and,

      ii. **The PWS must receive written TCEQ approval of the revised CT study prior to providing chloraminated water to the public.**

   d. If the system has a an approved CT study in place and a revised CT study is **not** required for the exception to be granted, the TCEQ's correspondence will contain the following conditions to be met by the PWS to receive the granted exception:

      i. The PWS's operators must change the disinfectant code entered for <disinfection zone> in the "Performance Data" on the SWMOR from "FCL" (free chlorine) to "CLA" (chloramines); and,

ii. The PWS must notify TROT at least 30 days prior to providing chloraminated water to the public.

e. If engineering plans and specifications and a revised CT study are both required, the CT study shall **not** be reviewed until a copy of the UTRT's correspondence issuing approval to construct has been received by TROT.

f. If engineering plans and specifications **are not required**, but a revised CT study was received with the written submittal, a TROT Team member who reviews CT studies shall review the exception request in conjunction with the CT study.

5. **Public Notification and TCEQ Notification:** All TCEQ correspondence that grants an exception to use chloramines as a disinfectant for PWSs that have not already been distributing chloraminated water will contain the following conditions to be met by the PWS prior to providing chloraminated water to the public:

   a. The PWS officials must provide public notice to all customers at least 14 days before the change to chloramines with emphasis on the fact that dialysis patients may be affected by the change. This notification must contain the Sample Language for Notification upon Changing from Free Chlorine to Chloramines included in Enclosure 1.

   b. The notification must be provided to the renal disease facilities, dialysis clinics, hospitals, physicians, local health departments, etc. The notice must state that the pretreatment scheme used for the dialysis unit should provide some means for removing chloramines, such as a charcoal filter.

   c. After the customers have been notified, the PWS must send a Certification of Delivery for Public Notice (see Enclosure 1) and a copy of the public notice to the TCEQ Plan & Technical Review Section (MC-159) at the following address:

      Plan & Technical Review Section (MC-159)
      Texas Commission on Environmental Quality
      P.O. Box 13087
      Austin, Texas 78711-3087

6. **Adequate Mixing:** Chlorine and ammonia must be mixed adequately in order to react fully and succeed in providing disinfection; the template letter includes a paragraph describing mixing recommendations and requirements. After chlorine injection, mixing should occur prior to ammonia injection. This may be accomplished by a static in-line mixer, or by at least five minutes of detention time in turbulent flow. A sampling location should be placed after chlorine injection and mixing, but prior to ammonia injection. Additionally, a sampling location should be placed after ammonia injection and mixing to represent the fully-formed chloramine levels.

   The general requirement is that chlorine must be added first, followed (after adequate mixing) with ammonia. The United States Environmental Protection Agency originally set this requirement in the guidance to the original Surface Water Treatment Rule to provide a safety factor for viral inactivation. More recent research has shown that by adding chlorine first, one can avoid the formation of the carcinogenic, although currently unregulated, n-nitrosodimethylamine (NDMA). Also, addition of chlorine will oxidize regulated forms of cyanide, rendering them harmless and avoiding the need for cyanide sampling. In some cases, ammonia may be added first

for groundwater that is neither under the influence of surface water (GUI) nor deemed hydrogeologically sensitive under the Groundwater Rule. For some groundwaters, naturally occurring ammonia may be used to form the chloramine. In either of the two latter cases, the conditions for dosing should be spelled out in detail in the letter: free ammonia must be measured prior to dosing chlorine.

7. **Periodic Sampling:** For a system to successfully use chloramines and avoid deleterious nitrification, the PWS must perform additional sampling in several locations, as compared with a system using free chlorine. The template letter includes a paragraph and table describing the required sampling. This sampling will vary depending on how the system uses chloramines.

    a. *Dosing chloramines:* Chlorine and ammonia may be added in a surface plant or groundwater plant. The chlorine should be measured prior to adding the ammonia. Often, not enough pipe length is present to add both the injection point and sampling point. However, it is highly recommended that both an injection point and sampling point be located after chlorine injection and before ammonia injection. In the case of initially dosing raw water, it is important to know whether there is a baseline level of free ammonia in the raw water. Additionally, it is important to know the baseline raw water contribution of nitrite and nitrate in order to respond to potential nitrification events.

    b. *Maintaining ("boosting") chloramines in distribution:* Any PWS that operates a distribution system must maintain at least the minimum level of total chlorine in the distribution system. The template letter includes a paragraph stating this requirement. When a PWS boosts the total chlorine level in distribution, the presence of free ammonia must be taken into account. The level of free available ammonia must be determined so that they don't overfeed additional ammonia, which could increase the risk of nitrification. Free ammonia is almost always present at low levels simply from feeding chloramines in a manner that ensures the presence of monochloramine. Additional free ammonia may be present from degradation of monochloramine or from intrusion. .

8. **Blending chloraminated and chlorinated water in distribution:** Mixing chlorinated and chloraminated water is not recommended. When the stream of water with free chlorine meets the stream of water with chloramines, the ratio of chlorine, ammonia, and monochloramine changes in an uncontrolled manner. If a PWS proposes to blend chlorinated and chloraminated water, they must perform sampling to ensure that the chlorine to ammonia-nitrogen ratio is maintained in a way that ensures formation of monochloramine, which is the only species that provides reliable disinfection. The template letter includes a paragraph regarding the potential issues related to blending chlorinated and chloraminated water. Often, a system will change or add new sources to maintain capacity. If a system proposes to start blending surface water with chloramines and well water with free chlorine, the PWS must first ensure that no unplanned blending occurs. A PWS that wishes to blend chlorinated and chloraminated water has the following alternatives.

    a. *Ammoniate the Chlorinated Water:* The PWS may use chloramines in the entire distribution system by adding ammonia after free chlorine injection to the well water that uses free chlorine. If the PWS wishes to pursue this option, they must provide the following information before making the interconnections:

        i. Documentation that the ammonia to be used at each downstream system is ANSI/NSF Standard 60 certified.

ii. Specifications (including model number and feed rate) for the ammonia pump(s).

iii. A description of the spill containment for the ammonia storage container(s), which must be able to hold at least 110% of the container's volume.

iv. A schematic or drawing of the water system, including current and proposed chlorine and ammonia injection point locations, water sources, storage tanks, etc. They should include whether they propose to change the type of chlorine used (i.e. liquid to gaseous).

v. Documentation showing that the PWS has the ability to test for free ammonia, monochloramines, and total chloramine.

If the PWS will be using anything other than liquid ammonium sulfate (LAS) in 55-gallon drums or smaller, engineering plans and specifications must be submitted to the TCEQ's Utilities Technical Review Team (MC 153) for review and receive approval to construct prior to construction as specified in 30 TAC §290.39(j)(1)(A)

b. *Break Point Chlorinate:* The PWS may use free chlorine in the entire distribution system. To do so, they must ensure that all of the water enters specific storage tanks prior to distribution - specifically, that chloraminated water must be delivered to a specific tank with chlorination facilities before distribution. Sufficient free chlorine must t hen be added to the specific storage tank(s) to transform("break point") the chloramines, and the PWS must monitor for free chlorine in the distribution system. Please note that due to the additional chlorine required for this option, the PWS may encounter elevated concentrations of disinfection byproducts. If the PWS wishes to pursue this option, they must provide the following information:

i. Drawings showing the piping modifications to be performed to deliver all the purchased chloraminated water to the storage tanks.

ii. Drawings of all current purchased water interconnections that currently feed to storage tanks.

iii. Locations of all chlorine injection and monitoring points at the storage tanks where chloraminated water will be introduced.

iv. Documentation of the method for determining the proper amount of chlorine to be added. The PWS should show the range of purchased water flow rates and chloramine residual expected.

c. *Do Not Blend:* The PWS may physically isolate areas of the distribution with free chlorine from areas with chloramines. Free chlorine should be monitored in the portions of the distribution system that are supplied solely by chlorinated water; free ammonia, monochloramine, and total chloramines should be monitored in the portions of the distribution system that are supplied by chloraminated water. If the PWS wishes to pursue this option, they must provide the following information:

i. A schematic or drawing of the above-referenced water systems, showing how the systems will be divided. The PWS should indicate which portion(s) will be disinfected with free chlorine and which portion disinfected with chloramines.

ii. Documentation showing that the PWS has the ability to test for free ammonia, monochloramine, and total chloramine.

d. *Ensure Controlled Blending:* For this option, a PWS must develop a method that will assure that chlorine residuals will remain acceptable in a blended distribution system by injecting the appropriate amount of chlorine in the well water to combine with free ammonia present in the chloraminated water. If the PWS wishes to pursue this option, they must provide the following information:

i. Documentation showing how the areas of blending were determined.

ii. Documentation showing how the areas of blending will be determined during actual operations. As demands change this area can also change. How will the PWS determine where the blending area is during purchased water usage?

iii. Documentation of the sampling type and frequency that the PWS will perform to assure adequate chlorine/chloramine residuals.

iv. Documentation of the sample type and frequency that the PWS will perform to assure monochloramine, not di- or tri-chloramine is being formed.

v. Documentation of the sample type and frequency that the PWS will perform to assure nitrification is not present in the blending area.

vi. Documentation of the corrective actions to be taken if the sampling shows inadequate disinfectant residuals, taste and odor issues, bacteriological sample issues, or potential nitrification.

vii. Documentation showing that the PWS has the ability to test for free ammonia, monochloramine, and total chloramine.

9. **Notification of reversion to free chlorine:** If a PWS performs a free chlorine "burn," they must notify the TCEQ's Drinking Water Quality Team (DWQT). The template letter contains a paragraph regarding notification. The TCEQ monitors disinfection byproduct (DBP) levels at all public water systems, as required by30 TAC §290.113 and 30 TAC §290.115. The PWS may find that it needs to revert back to free chlorine periodically to control the levels of nitrifying bacteria in its distribution system. This reversion process may result in temporary increases in DBP levels, but it will not reflect normal operating conditions if it is accomplished in a month or less (10% of the time).. Consequently, the TCEQ's DWQT may adjust a system's DBP monitoring schedule during these events. To ensure that DBP samples are not collected under abnormal operating conditions, the PWS must notify the TCEQ of any temporary reversion back to free chlorine. These notices should be issued in the following manner:

a. The notice should state the date that the system will begin distributing water with a free chlorine residual as well as the anticipated duration of the event.

b. The notice to TCEQ should be sent via email to DBP@tceq.texas.gov, fax to (512) 239-6050, phone at (512) 239-4691, or correspondence to:

Drinking Water Quality Team (MC 155)
Attn: DBP Rule Coordinator
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

c. Public water systems that wholesale chloraminated water are required to notify wholesale customers in writing or via fax that they are temporarily switching to free chlorine at least 14 days before the reversion begins.

10. **Enclosures:** The most recent versions of two documents must be attached to the letter:

1. Public Notice Requirements for Systems Converting to Chloramines and Certificate of Delivery
2. Monitoring Plan Alert and Action Levels

Finalized and Approved by: Ada Lichaa, Plan & Technical Review Section, Manager

Revision History:

Date	Action	Action by
4/1/2004	Approved	Buck Henderson
4/30/2014	Revised	Alicia Diehl
5/8/2014	Approved Aida Lichaa	Ada Lichaa

Enclosure 1: Public Notice Materials

A public water system (PWS) must notify its customers, in writing, at least 14 days prior to commencing the use of chloramines. This notification must contain the Sample Language for Notification Upon Changing from Free Chlorine to Chloramines included below. The notification should be provided to the news media, renal disease facilities, dialysis clinics, hospitals, physicians, local health departments, etc.

Sample Language for Notification Upon Changing from Free Chlorine to Chloramines

*"On <**Date**>, the <**Water System Name**> will be changing the disinfectant that we use from chlorine to chloramines. This change is intended to benefit our customers by reducing the levels of disinfection byproducts (DBPs) in the system, while still providing protection from waterborne disease.*

However, the change to chloramines can cause problems to persons dependent on dialysis machines. A condition known as hemolytic anemia can occur if the disinfectant is not completely removed from the water that is used for the dialysate. Consequently, the pretreatment scheme used for the dialysis units must include some means, such as a charcoal filter, for removing the chloramine prior to this date. Medical facilities should also determine if additional precautions are required for other medical equipment. In addition, chloraminated water may be toxic to fish. If you have a fish tank, please make sure that the chemicals or filters that you are using are designed for use in water that has been treated with chloramines. You may also need to change the type of filter that you use for fish tanks."

***OPTIONAL:** "When the chloraminated water first flushes out the chlorinated water there may be a slight taste and odor, and possibly discoloration for a short period of time. This will not compromise the safety of the water."*

Spanish Language for Notification Upon Changing from Free Chlorine to Chloramines

*"El <**Date**>, el <**Water System Name**> cambiará el desinfectante de cloro que usamos a otro de cloramina. El propósito de este cambio es beneficiar a nuestros clientes reduciendo los niveles de los productos secundarios relacionados a la desinfección (DBPs) en el sistema, proporcionando al mismo tiempo la protección contra las enfermedades originadas por los gérmenes del agua.*

No obstante, el cambio a cloramina puede causar problemas a las personas cuya vida depende de las máquinas de diálisis. Si el desinfectante no es completamente eliminado del agua que se usa para la diálisis, puede conducir a una anemia hemolítica. Por lo tanto, el esquema de tratamiento previo usado por las unidades de diálisis debe incluir algunos medios, tales como filtros de carbón, para eliminar la cloramina antes de esta fecha. Las instituciones médicas deben determinar si otros equipos médicos también pueden requerir precauciones adicionales. Además, el agua con cloramina podría ser tóxica para los peces. Si tiene un tanque para peces, asegúrese de que los filtros o los productos químicos que están siendo usados están diseñados para ser usados en agua que ha sido tratada con cloramina. También puede ser necesario cambiar el tipo de filtro que usa para el tanque."

***OPCIONAL:** "Al tiempo de la primera aspersión del agua cloraminada, se puede percibir por periodos cortos de tiempo algún sabor, olor y posiblemente alguna pérdida del color del agua. Esto no compromete la seguridad del agua."*

Important notes:

1. The PWS may not begin using chloramines prior to the date shown in the notice.

2. The TCEQ does not currently require the PWS to include the name or contact number of a PWS employee that the customers can contract if they have questions. However, several systems have included this additional information as a courtesy to its consumers.

Some PWSs find it beneficial to periodically convert back to free chlorine for 21-28 days once or twice each year. This procedure can minimize the growth of nitrifying bacteria and make it easier to maintain an adequate chloramine residual during the rest of the year. If the PWS wishes to use this procedure, it must notify the TCEQ and any wholesale customer prior to making this type of temporary switch. The TCEQ also suggests that the PWS notify its customers just days before making the temporary change because this procedure occasionally results in slight changes in the taste and odor of the water. However, it does not have to reissue the public notice described above.

Texas Commission on Environmental Quality
CERTIFICATION of DELIVERY of PUBLIC NOTICE to CUSTOMERS

Public Water System (PWS) Name: _____

PWS I.D. (7-digit number required): _____

Date of Change to Chloramines: _____

I,_____, certify that the following information is true and accurate: (signature)

- The public water system named above has distributed the Public Notice (PN) for changing the disinfectant to chloramines at least 14 days prior to the change by mail or direct delivery to bill-paying customers; **and**
- The information contained in this public notification is correct and complies with required public notification condition in the letter authorizing the public water system to use chloramines; **and**
- The above system has made an adequate good-faith effort to reach non-bill-paying consumers by appropriate methods as follows (check all that apply):

_____ Posting the PN on the Internet at www._____
_____ Mailing the PN to postal patrons within the service area that do not receive a bill
_____ Advertising the PN in news media
_____ Publication of PN in local newspaper
_____ Posting the PN in public places
_____ Delivery of multiple copies to single bill addresses serving several persons
_____ Delivery to community organizations

Date of Delivery to Customers: _____

Certified by: Name (print): _____

Title: _____

Phone No: _____ Date: _____

Signature: _____

Send one copy of this completed form and one copy of the Public Notification that you delivered to your customers to:

Plan and Technical Review Section - Mail Code 159
Texas Commission on Environmental Quality
P. O. Box 13087
Austin, Texas 78711-3087

Enclosure 2: Monitoring Plan Alert and Action Levels

Note: *This is intended to help you develop a system-specific flow chart for your system. You need to set system specific baseline and action levels and responses. If you don't understand the reason for a change or corrective action recommended by this flow chart, review your training and/or contact the TCEQ to request on-site assistance.*

Setting Baseline & Action Levels

Monitor daily/weekly at sites representative of distribution system (in milligrams per liter (mg/L)) for disinfectants and ammonia:

- Total Available Chlorine (**TAC** or "combined" chlorine)
- Monochloramine ("**Mono**")
- Free Available Ammonia (**FAA**)

Set **Action Levels (ALs)** for each disinfection chemical:

▶**AL-1:** Normal operating level.
Exceeding an AL-1 triggers follow up with additional sampling and possibly dose change.

▶**AL-2:** Moderately off-spec water.
Exceeding the AL-2 triggers additional sampling and moderate corrective action such as flushing or changing chemical feed.

▶**AL-3:** Potential risk, potential violation.
Exceeding the AL-3 triggers immediate corrective action, additional sampling, and potential notification of customers

Monitor weekly/monthly at entry point and representative distribution site(s):

- Nitrite (**NO2**) (& Nitrate (**NO3**)) *(Labs do these tests together)*
- Heterotrophic Plate Count (on R2A agar) (**HPC**) measured in colony-forming units per milliliter (cfu/mL) *(Recommendation, not requirement)*

Determine **Baselines (BLs)**—the system-specific background level for naturally occurring nitrate, nitrite and HPC. The BL will be the level one trigger (like AL-1) for nitrite, nitrate, and HPC.

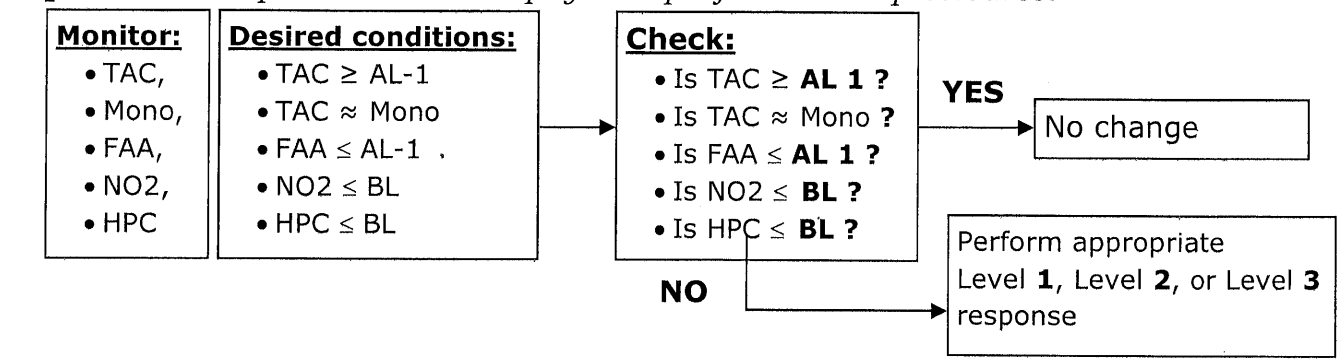
▶**BL:** Baseline. The normal, naturally occurring level of a constituent.
▶**AL-2:** Moderately off-spec water. Triggers moderate action.
▶**AL-3:** Potential risk, potential violation. Triggers immediate correction

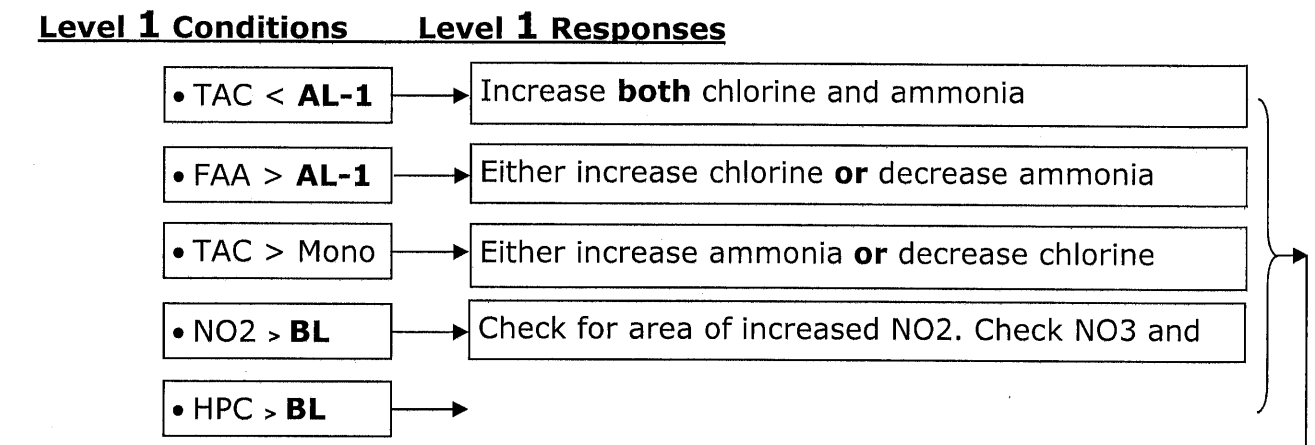
EXAMPLE Chloramine Alert and Action Levels

Parameter	Target at Entry Point (EP)	Target in Distribution	AL-1: Alert	AL-2: Action Needed	AL-3: Violation Possible
TAC (mg/L)	≥ 2 mg/L	≥ 1.6 mg/L	1.4 mg/L	1 mg/L	0.5 mg/L
NO2 (mg/L)	At baseline	At baseline	0.1 mg/L over baseline	0.2 mg/L over baseline	0.4 mg/L over baseline
FAA (mg/L)	~0.1 mg/L	~ 0.3 mg/L	0.5 mg/L	1 mg/L	2 mg/L
HPC (mg/L)*	< 100 cfu/mL	< 100 cfu/mL	> 100 cfu/mL	> 200 cfu/mL	> 500 cfu/mL

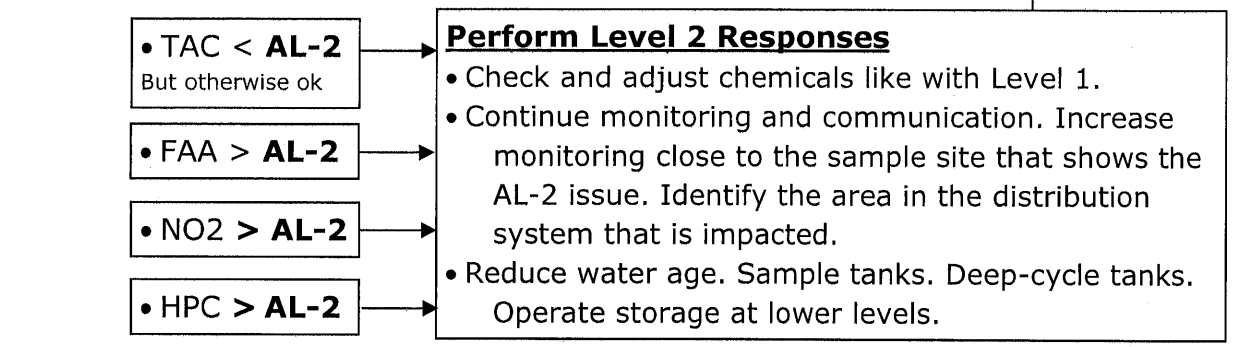
* HPC is recommended, but not required. HPC varies a great deal between systems.

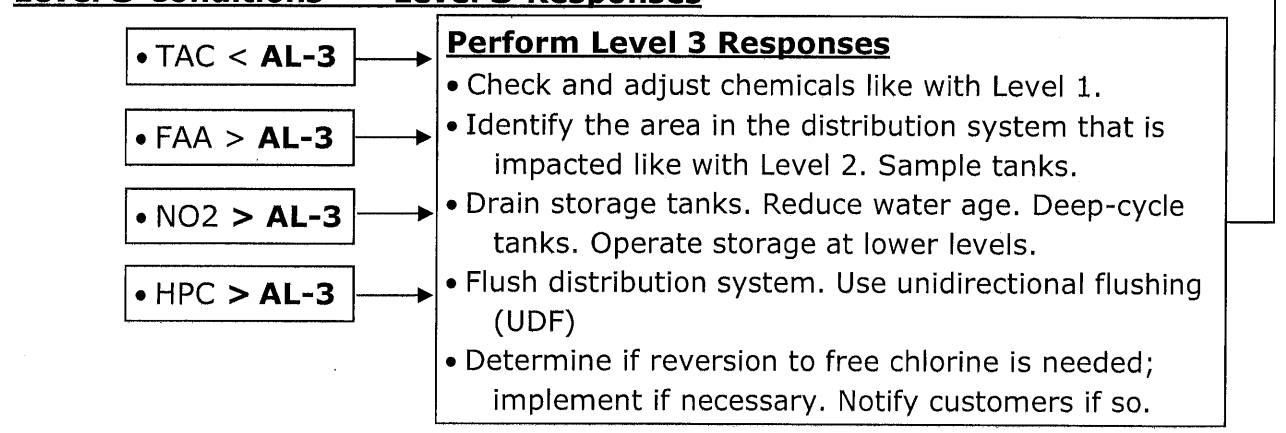
This is an example. You must develop system-specific levels and procedures.





Are levels back to normal? If so, done. If not, repeat / increase





The following table is provided for your convenience, to record your site-specific Alert, Action, and Base Line levels:

BLANK Chloramine Alert and Action Levels

Parameter	Target at EP	Target in Distribution	AL-1: Alert	AL-2: Action Needed	AL-3: Violation Possible
TAC (mg/L)					0.5 mg/L
NO2 (mg/L)					
FAA (mg/L)					
HPC (mg/L)*					

* Remember, HPC is recommended, but not required. HPC varies a great deal between systems.
** You can use this blank table to document your system-specific levels.

Table 1. Critical Control Parameters for Chloramination

Parameter	Level or ratio	Reason
Total chlorine (TAC)	0.5 mg/L	Minimum regulatory limit.
Ratio of total chlorine to Monochloramine (TAC:Mono)	Plus or minus 10%	If most of the chlorine is present as monochloramine (as desired), the levels of total chlorine and monochloramine should be almost equal—within 10% is good.
Ratio of total chlorine to Free ammonia (TAC:FAA)	2 to 3 times	If the total chlorine is 2 to 3 times the free ammonia, it means there is an effective disinfectant residual present to help control potential nitrifying organisms.
Free available ammonia (as nitrogen) (FAA)	Low	Industry recommendations range from 0 to 0.3 mg/L free ammonia. Some systems operate with as much as 0.5 mg/L. The more ammonia that is present, the more 'food' available for nitrifying organisms. **NOTE:** Most test equipment can only measure up to 0.55 mg/L. If you measure 0.55 mg/L, you must dilute the sample and calculate the actual concentration.
	Present	When there is a little bit of free ammonia present, it indicates that monochloramine is the dominant species, as desired.
Free chlorine (FCL)	Very low/ absent	Most methods show a very small amount of free chlorine in every test—a "drop." The level should not be over about 0.1 mg/L, or it is recommended that the method be checked for accuracy. Letting a sample sit--for example to allow bubbles to dissipate--can give falsely high free chlorine readings
Nitrite (NO2-)	Equal to baseline	Most source water contains trace amounts of nitrite or nitrate, or both. Low levels are not of concern, but if levels within the distribution system are greater than the baseline levels, it can indicate either nitrification or intrusion of fecal matter. A change of 0.1 to 0.2 or 15% should be followed up on with additional sampling to verify whether nitrification is occurring.
Nitrate (NO3-)		

Entry Point Nitrite/Nitrate Data

The TCEQ requires periodic nitrite and nitrate monitoring for all public water systems. You may be able to use the entry point nitrite and nitrate levels from this compliance monitoring as your Base Line levels, particularly if the entry point represents a single well.

If your entry point(s) represents water from more than one well, you will need to do monitoring to determine the contribution of nitrite and nitrate from each source. Then, if you have an unusual nitrite or nitrate reading in the distribution system, you will be able to tell if it is due to a particular well or other source.

The TCEQ's data for your system is available on-line on our Drinking Water Watch web site at:

dww.tceq.state.tx.us/DWW/

Data management

At a minimum, you must record the measured distribution system levels by hand and keep those data sheets. A blank example of a chloramine data sheet is provided below:

Blank Example of a Chloramine Data Sheet

PWS Name _____ **Operator name** _____

(Target Free Chlorine = ____ mg/L) **Date**_____

Location Address	Total Chlorine	Mono-chlor-amine	Free Ammo-nia	Free Chlor-ine	Mono: Total %	Trigger Exceeded? Y/N	Nitrite/Nitrate (if triggered, note date and time of collection)	
							Nitrite	Nitrate

Note – this data sheet may work better if you format it in "landscape" instead of "portrait."

You may be able to track the data better and optimize your system by recording it in a computer spreadsheet program like Microsoft Excel or Corel QuattroPro. The benefit of those programs is that they can be used to do calculations of the percent of monochloramine, the ratio of total chlorine to ammonia, and other useful calculations.

Record retention

You must retain your distribution monitoring for at least three years, and have it available for the TCEQ's Regional Investigators to look at during their visits. If you use an electronic record keeping system, you should be able to provide printouts to the TCEQ upon request. Other considerations for electronic recordkeeping include:

- Back up. You should routinely back up your data. Computer glitches can lose your data.
- Organization: You should give files unique names that clearly specify the data they contain, like the specific month and year. A good example of a file name is "2014-March-ChloramineData.xlsx." An example of a bad file name is "data.xlsx."